INTERNATIONAL JOURNAL OF

MACHINE TOOLS & MANUFACTURE

DESIGN, RESEARCH AND APPLICATION

(formerly Machine Tool Design & Research)

Editor-in-Chief:
T. A. Dean

VOLUME 40, 2000

VOLUME CONTENTS AND AUTHOR INDEX

PERGAMON

International Journal of MACHINE TOOLS & MANUFACTURE Design, Research and Application

Editor-in-Chief: T. A. Dean

School of Manufacturing and Mechanical Engineering, The University of Birmingham, Edgbaston, Birmingham B15 2TT, U.K.

Regional Editors

Prof. H. A. Al-Qureshi, Instituto Tecnólogico de Aeronautica, Departamento de Tecnologia, IEM, Campo Montenegro, CTA, 12.225-São José dos Campos-SP, Brazil.

Prof. Choon Seong Leem, School of Electrical and Mechanical Engineering, Yonsei University, 134 Shinchon Dong, Sudaemoon-ku, Seoul 120-749, Korea.

Prof. Zigong Zhang, Mechanical Engineering, Xi'an Jiaotong University, Shaanxi Province, P.R. of China.

Prof. G. F. Micheletti, Strada del Mylius 16, Moncalieri, Italy.

Prof. K. Kondo, Toyota Technological Institute, 2-12-1 Hisakata Tempaku, Nagoya 468-8511, Japan.

Prof. W. A. Knight, Industrial & Mfg Eng Dept, University of Rhode Island, Kingston, RI 02881, U.S.A.

Reviewing Committee

T. Altan, Columbus, Ohio, U.S.A.
G. Barrow, Manchester, U.K.
R. Bell, Loughborough, U.K.
L. Blunt, Huddersfield, U.K.
M. F. DeVries, Madison, Wisc., U.S.A.
R. C. Dewes, Birmingham, U.K.
W. P. Dong, Lawrenceville, N.J., U.S.A.
F. El-Menshawy, Birmingham, U.K.
R. S. Hahn, Auburn, Mass., U.S.A.
F. R. Hall, Wolverhampton, U.K.
W. Heginbotham, Nottingham, U.K.
U. Heisel, Stuttgart, Germany.
D. C. Hodgson, Birmingham, U.K.
C. Hooke, Birmingham, U.K.
B. Jones, Aston, U.K.
M. Kiuchi, Tokyo, Japan.
C. H. Ku, Xi'an, China.
N. Leighton, Malmesbury, U.K.
M. Loftus, Birmingham, U.K.
P. Mathew, Kensington, NSW, Australia.
R. F. O'Connor, Coventry, U.K.
K. Osakada, Osaka, Japan.
D. T. Pham, Cardiff, U.K.
I. Pillinger, Birmingham, U.K.
G. Reinhart, Garching, Germany.
W. B. Rowe, Liverpool, U.K.
T. Shirakashi, Tokyo, Japan.
G. Spur, Berlin, Germany.
I. N. Tansel, Miami, Flor., U.S.A.
R. H. Thornley, Birmingham, U.K.
D. Walton, Birmingham, U.K.
H. J. Warnecke, Stuttgart, Germany.
A. R. Watson, Campbell, Australia.
J. Webster, Worcester, Mass., U.S.A.
M. Weck, Aachen, Germany.
M. L. Wise, Birmingham, U.K.
I. Yellowley, British Columbia, Canada.
B. S. Yilbas, Dhahran, Saudi Arabia.

Publishing Office

Elsevier Science Ltd, The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, U.K.
Tel: (01865) 843000; Fax (01865) 843010.

Advertising Information

Advertising orders and enquiries can be sent to: **USA, Canada and South America:** Mr Tino de Carlo, The Advertising Department, Elsevier Science Inc., 655 Avenue of the Americas, New York, NY 10010-5107, USA; phone: (+1) (212) 633 3815; fax: (+1) (212) 633 3820; e-mail: t.decarlo@elsevier.com. **Japan:** The Advertising Department, Elsevier Science K.K., 9-15 Higashi-Azabu 1-chome, Minato-ku, Tokyo 106-0044, Japan; phone: (+81) (43) 5561 5033; fax: (+81) (3) 5561 5047. **Europe and ROW:** Rachel Leveson-Gower, The Advertising Department, Elsevier Science Ltd, The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, UK; phone: (+44) (1865) 843565; fax: (+44) (1865) 843976; e-mail: r.leveson-gower@elsevier.co.uk.

Author Service Department

For queries relating to the general submission of articles (including electronic text and artwork) and the status of accepted manuscripts, please contact the Author Service Department: e-mail: authors@elsevier.co.uk; fax: + 44 (0) 1865 843905; tel: + 44 (0) 1865 843900.

Publication information: *International Journal of Machine Tools & Manufacture* (ISSN 0890-6955). For 2001, volume 41 is scheduled for publication. Subscription prices are available upon request from the Publisher or from the Regional Sales Office nearest you or from this journal's website (http://www.elsevier.com/locate/ijmactool). Further information is available on this journal and other Elsevier Science products through Elsevier's website (http://www.elsevier.nl). Subscriptions are accepted on a prepaid basis only and are entered on a calendar year basis. Issues are sent by standard mail (surface within Europe, air delivery outside Europe). Priority rates are available upon request. Claims for missing issues should be made within six months of the date of dispatch.

Orders, claims, and product enquiries: please contact the Customer Support Department at the Regional Sales Office nearest you: **New York**: Elsevier Science, PO Box 945, New York, NY 10159-0945, USA; phone: (+1) (212) 633 3730 [toll free number for North American customers: 1-888-4ES-INFO (437-4636)]; fax: (+1) (212) 633 3680; e-mail: usinfo-f@elsevier.com. **Amsterdam**: Elsevier Science, PO Box 211, 1000 AE Amsterdam, The Netherlands; phone: (+31) 20 4853757; fax: (+31) 20 4853432; e-mail: nlinfo-f@elsevier.nl. **Tokyo**: Elsevier Science, 9-15 Higashi-Azabu 1-chome, Minato-ku, Tokyo 106-0044, Japan; phone: (+81) (3) 5561 5033; fax: (+81) (3) 5561 5047; info@elsevier.co.jp. **Singapore**: Elsevier Science, No. 1 Temasek Avenue, #17-01 Millenia Tower, Singapore 039192; phone: (+65) 434 3727; fax: (+65) 337 2230; e-mail: asiainfo@elsevier.com.sg. **Rio de Janeiro**: Elsevier Science, Rua Sete de Setembro 111/16 Andar, 20050-002 Centro, Rio de Janiero - RJ, Brazil; phone: (+55) (21) 509 5340; fax: (+55) (21) 507 1991; e-mail: elsevier@campus.com.br [Note (Latin America): for orders, claims and help desk information, please contact the Regional Sales Office in New York as listed above].

Periodicals postage paid at Rahway, New Jersey. *International Journal of Machine Tools and Manufacture* (ISSN 0890-6955) is published fifteen times per year by Elsevier Science Ltd, The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, UK. The annual subscription in the USA is $2273. *International Journal of Machine Tools & Manufacture* is circulated by Mercury International Limited, 365 Blair Road, Avenel, NJ 07001, USA.

POSTMASTER: Please send address corrections to: *International Journal of Machine Tools & Manufacture*, c/o Customer Services, Elsevier Science Inc, 655 Avenue of the Americas, New York, NY 10010, USA

VOLUME CONTENTS

Number 1

P.-H. Hu and K. F. Ehmann	1	A dynamic model of the rolling process. Part I: homogeneous model
P.-H. Hu and K. F. Ehmann	21	A dynamic model of the rolling process. Part II: inhomogeneous model
C. M. Lee and D. Y. Yang	33	A three-dimensional steady-state finite element analysis of square die extrusion by using automatic mesh generation
Z. Pater	49	Theoretical and experimental analysis of cross wedge rolling process
D.-K. Leu	65	The curling characteristics of static inside-out inversion of metal tubes
C. Xie, X. Dong, S. Li and S. Huang	81	Rigid–viscoplastic dynamic explicit FEA of the ring rolling process
N. Venkata Reddy, P. M. Dixit and G. K. Lal	95	Ductile fracture criteria and its prediction in axisymmetric drawing
H. Yao, B. L. Kinsey and J. Cao	113	Rapid design of corner restraining force in deep drawn rectangular parts
T. Özel and T. Altan	133	Determination of workpiece flow stress and friction at the chip–tool contact for high-speed cutting

Number 2

J. Marafona and C. Wykes	153	A new method of optimising material removal rate using EDM with copper–tungsten electrodes
X.-B. Wang, H.-M. Shi and J.-X. Ren	165	An investigation on the transformations in grinding affected layer of ZTC
A. Di Ilio and A. Paoletti	173	A comparison between conventional abrasives and superabrasives in grinding of SiC-aluminium composites
A. Warkentin, F. Ismail and S. Bedi	185	Comparison between multi-point and other 5-axis tool positioning strategies
S. Ebbrell, N. H. Woolley, Y. D. Tridimas, D. R. Allanson and W. B. Rowe	209	The effects of cutting fluid application methods on the grinding process
E. Susič and I. Grabec	225	Characterization of the grinding process by acoustic emission
R. J. Seethaler and I. Yellowley	239	Process control and dynamic process planning
H. Qui, Y. Li, K. Cheng and Y. Li	259	A practical evaluation approach towards form deviation for two-dimensional contours based on coordinate measurement data
G. M. Kim, P. J. Cho and C. N. Chu	277	Cutting force prediction of sculptured surface ball-end milling using Z-map
G. T. Smith	293	Ternary manufacturing envelopes (TMEs)—a new approach to describing machined surfaces

Number 3

C.-C. Lo	307	CNC machine tool surface interpolator for ball-end milling of free-form surfaces
S.-Y. Chou and C.-W. Sun	327	Assessing cylindricity for oblique cylindrical features
Y. J. G. Liao and S. J. Hu	343	Flexible multibody dynamics based fixture-workpiece analysis model for fixturing stability

J. G. Zhou, D. Herscovici and C. C. Chen 363 Parametric process optimization to improve the accuracy of rapid prototyped stereolithography parts

S.-L. Chen and Y. W. Jen 381 Data fusion neural network for tool condition monitoring in CNC milling machining

M. S. Shunmugam, S. V. Bhaskara Reddy and T. T. Narendran 401 Selection of optimal conditions in multi-pass face-milling using a genetic algorithm

C. K. H. Dharan and M. S. Won 415 Machining parameters for an intelligent machining system for composite laminates

W.-S. Kim and S. Raman 427 On the selection of flatness measurement points in coordinate measuring machine inspection

C. Li, S. Dong and G. Zhang 445 Evaluation of the root-mean-square slope of 3D surface topography

W. Chen 455 Cutting forces and surface finish when machining medium hardness steel using CBN tools

Number 4

W. Xie, E. C. De Meter and M. W. Trethewey 467 An experimental evaluation of coefficients of static friction of common workpiece–fixture element pairs

A. J. Patel and K. F. Ehmann 489 Calibration of a hexapod machine tool using a redundant leg

J. S. Chen and I. C. Dwang 513 A ballscrew drive mechanism with piezo-electric nut for preload and motion control

C. Zhang, T. Kato, W. Li and H. Ohmori 527 A comparative study: surface characteristics of CVD-SiC ground with cast iron bond diamond wheel

D. Renton and M. A. Elbestawi 539 High speed servo control of multi-axis machine tools

N. Lynagh, H. Rahnejat, M. Ebrahimi and R. Aini 561 Bearing induced vibration in precision high speed routing spindles

K. Krishnakumar and S. N. Melkote 579 Machining fixture layout optimization using the genetic algorithm

I. N. Tansel, T. T. Arkan, W. Y. Bao, N. Mahendrakar, B. Shisler, D. Smith and M. McCool 599 Tool wear estimation in micro-machining. Part I: tool usage–cutting force relationship

I. N. Tansel, T. T. Arkan, W. Y. Bao, N. Mahendrakar, B. Shisler, D. Smith and M. McCool 609 Tool wear estimation in micro-machining. Part II: Neural-network-based periodic inspector for non-metals

Number 5

T. A. Dean 621 Obituary: Professor Peter Louis Brennan Oxley

D. R. Gunasegaram, I. M. Bidhendi and N. J. McCaffrey 623 Modelling the casting process of plastic ophthalmic lenses

R. Y. Chiou and S. Y. Liang 641 Dynamic modeling of cutting acoustic emission via piezo-electric actuator wave control

C. Zhang, H. Ohmori and W. Li 661 Precision shaping of small diameter wheels using micro electric discharge truing (MEDT) and hole-machining of Al_2O_3 material

H.-S. Yan and W.-R. Chen 675 A variable input speed approach for improving the output motion characteristics of Watt-type presses

Z. Gao and R. V. Grandhi 691 Microstructure optimization in design of forging processes

T. Özel and T. Altan 713 Process simulation using finite element method — prediction of cutting forces, tool stresses and temperatures in high-speed flat end milling

D. E. Dimla Sr. and P. M. Lister 739 On-line metal cutting tool condition monitoring. I: force and vibration analyses

D. E. Dimla Sr. and P. M. Lister 769 On-line metal cutting tool condition monitoring. II: tool-state classification using multi-layer perceptron neural networks

Number 6

B.-C. Wu, G.-S. Young and T.-Y. Huang 783 Application of a two-level optimization process to conceptual structural design of a machine tool

J. Zhao, J. Zhan, R. Jin and M. Tao 795 An oblique ultrasonic polishing method by robot for free-form surfaces

M. Aleyaasin, R. Whalley and M. Ebrahimi 809 Error correction in hydrostatic spindles by optimal bearing tuning

C. Z. Huang, J. Wang and X. Ai 823 Development of new ceramic cutting tools with alumina coated carbide powders

N. A. Barakat, M. A. Elbestawi and A. D. Spence 833 Kinematic and geometric error compensation of a coordinate measuring machine

K. H. Raj, R. S. Sharma, S. Srivastava and C. Patvardhan 851 Modeling of manufacturing processes with ANNs for intelligent manufacturing

C. E. Becze, P. Clayon, L. Chen, T. I. El-Wardany and M. A. Elbestawi 869 High-speed five-axis milling of hardened tool steel

S. K. Choudhury and G. Raju 887 Investigation into crater wear in drilling

S. K. Choudhury and K. K. Kishore 899 Tool wear measurement in turning using force ratio

D. J. Kim and B. M. Kim 911 Application of neural network and FEM for metal forming processes

Number 7

R. Y. Chiou and S. Y. Liang 927 Analysis of acoustic emission in chatter vibration with tool wear effect in turning

P.-C. Tung, S.-R. Wang and K. Lo 943 Application of self-tuning fuzzy controller for a Cartesian manipulator on unknown contours

S.-C. Chen and P.-C. Tung 957 Trajectory planning for automated robotic deburring on an unknown contour

C. F. Cheung and W. B. Lee 979 A theoretical and experimental investigation of surface roughness formation in ultra-precision diamond turning

V. K. Jain and S. G. Adsul 1003 Experimental investigations into abrasive flow machining (AFM)

B. S. Yilbas, S. Z. Shuja and M. O. Budair 1023 Nano-second laser pulse heating and assisting gas jet considerations

S. Mekid 1039 High precision linear slide. Part I: design and construction

S. Mekid and O. Olejniczak 1051 High precision linear slide. Part II: control and measurements

H. Yang and S.-W. Kang 1065 Improvement of thickness uniformity in nickel electroforming for the LIGA process

Number 8

D. E. Dimla Snr. 1073 Sensor signals for tool-wear monitoring in metal cutting operations—a review of methods

J. A. Badger and A. A. Torrance 1099 A comparison of two models to predict grinding forces from wheel surface topography

S. Sastry, S. G. Kapoor and R. E. DeVor 1121 Compensation of progressive radial run-out in face-milling by spindle speed variation

S. Ema and E. Marui 1141 Suppression of chatter vibration of boring tools using impact dampers

N. Tounsi and A. Otho 1157 Dynamic cutting force measuring

F. Barré and J. Lopez 1171 Watershed lines and catchment basins: a new 3D-motif method

P. J. Cheng and S. C. Lin 1185 Using neural networks to predict bending angle of sheet metal formed by laser

A. C. Okafor and Y. M. Ertekin 1199 Derivation of machine tool error models and error compensation procedure for three axes vertical machining center using rigid body kinematics

S. B. Tor, S. G. Lee and S. H. Chung Yee Hian 1215 A two-stage collapsible core for injection moulded plastic parts with internal undercuts

Number 9

R. Ramesh, M. A. Mannan and A. N. Poo 1235 Error compensation in machine tools — a review
Part I: geometric, cutting-force induced and fixture-dependent errors

R. Ramesh, M. A. Mannan and A. N. Poo 1257 Error compensation in machine tools — a review
Part II: thermal errors

A. Forcellese and F. Gabrielli 1285 Warm forging of aluminium alloys: a new approach for time compression of the forging sequence

M. Starbek and D. Menart 1299 The optimization of material flow in production

J.-H. Hwang, D.-C. Ko, G.-S. Min, B.-M. Kim and J.-C. Choi 1311 Finite element simulation and experiment for extrusion of semi-solid Al 2024

D.-C. Ko and B.-M. Kim 1329 Development of an analytical scheme to predict the need for tool regrinding in shearing processes

F. Müller and J. Monaghan 1351 Non-conventional machining of particle reinforced metal matrix composite

N. Tounsi and A. Otho 1367 Identification of machine–tool–workpiece system dynamics

Number 10

J. A Yang, J. Jouraij and R. Du 1385 Controlling toolholder fretting through simple design modifications

B. H. Yan, C. C. Wang, H. M. Chow and Y. C. Lin 1403 Feasibility study of rotary electrical discharge machining with ball burnishing for Al_2O_3/6061Al composite

V. Portman 1423 Deterministic metrology of platform-type machine tools

B. K. Hinds and G. M. Treanor 1443 Analysis of stresses in micro-drills using the finite element method

S. K. Lee, D. C. Ko and B. M. Kim 1457 Optimal die profile design for uniform microstructure in hot extruded product

S. H. Zhang, L. H. Lang, D. C. Kang, J. Danckert and K. B. Nielsen 1479 Hydromechanical deep-drawing of aluminium parabolic workpieces—experiments and numerical simulation

H. J. Pahk, S. W. Lee and D. S. Lee 1493 Computer aided measurement and compensation system for focal length of lenses in camera manufacture based on the MTF performance using the line CCD sensor

R.-S. Lin 1513 Real-time surface interpolator for 3-D parametric surface machining on 3-axis machine tools

C. D. Mize and J. C. Ziegert 1527 Durability evaluation of software error correction on a machining center

M. Rahman, J. Heikkala and K. Lappalainen 1535 Modeling, measurement and error compensation of multi-axis machine tools. Part I: theory

Number 11

K. J. Fernandes and V. H. Raja 1547 Incorporated tool selection system using object technology

H.-Y. Feng and N. Su 1557 Integrated tool path and feed rate optimization for the finishing machining of 3D plane surfaces

S. Xiong, X. Liu and G. Wang 1573 Analysis of non-steady state slab edging in roughing trains by a three-dimensional rigid-plastic finite element method

W. Hu, A. G. Starr, Z. Zhou and A. Y. T. Leung 1587 A systematic approach to integrated fault diagnosis of flexible manufacturing systems

M. H. El-Axir 1603 An investigation into roller burnishing

N. H. Abu-Zahra and G. Yu 1619 Analytical model for tool wear monitoring in turning operations using ultrasound waves

Z. M. Hu and T. A. Dean 1637 A study of surface topography, friction and lubricants in metalforming

H. Hocheng, H. Y. Tsai and M. S. Tsai 1651 Effects of kinematic variables on nonuniformity in chemical mechanical planarization

J.-R. Lin 1671 Surface roughness effect on the dynamic stiffness and damping characteristics of compensated hydrostatic thrust bearings

Number 12

L.-P. Lei, J. Kim and B.-S. Kang 1691 Analysis and design of hydroforming process for automobile rear axle housing by FEM

Q. Meng, J. A. Arsecularatne and P. Mathew 1709 Calculation of optimum cutting conditions for turning operations using a machining theory

F. Kolahan and M. Liang 1735 Optimization of hole-making operations: a tabu-search approach

A. J. Shih 1755 An experimental investigation of rotary diamond truing and dressing of vitreous bond wheels for ceramic grinding

A. M. Hassan and A. M. S. Momani 1775 Further improvements in some properties of shot peened components using the burnishing process

A. A. Torrance and J. A. Badger 1787 The relation between the traverse dressing of vitrified grinding wheels and their performance

I. Cho, K. Lee, W. Choi and Y.-A. Song 1813 Development of a new sheet deposition type rapid prototyping system

Number 13

M.İ. Gökler and A.M. Ozanözgü 1831 Experimental investigation of effects of cutting parameters on surface roughness in the WEDM process

N.R. Chitkara and M.A. Bhutta 1849 Computer simulation to predict stresses, working pressures and deformation modes in near-net shape heading of a tapered circular bolt with a square head

C. Chungchoo and D. Saini 1879 The total energy and the total entropy of force signals — new parameters for monitoring oblique turning operations

W.-Y. Jywe and C.-H. Liu 1899 Verification and evaluation method for volumetric and positional errors of CNC machine tools

C.-C. Tai and M.-C. Huang 1913 The processing of data points basing on design intent in reverse engineering

D.W. Smithey, S.G. Kapoor and R.E. DeVor 1929 A worn tool force model for three-dimensional cutting operations

V. Bhat and E.C. De Meter 1951 An analysis of the effect of datum-establishment methods on the geometric errors of machined features

Number 14

G. García-Gil and R. Colás 1977 Calculation of thermal crowning in work rolls from their cooling curves

T. Pyttel, R. John and M. Hoogen 1993 A finite element based model for the description of aluminium sheet blanking

M. Alfares and A. Elsharkawy 2003 Effect of grinding forces on the vibration of grinding machine spindle system

M.J. Kelly and D.J. Toncich 2031 Overcoming encoder quantisation noise in an adaptive position controller

H. Li and X. Li 2047 Modelling and simulation of chatter in milling using a predictive force model

K.C. Fan and Y. Zhao 2073 A laser straightness measurement system using optical fiber and modulation techniques

P.-C. Tung, S.-R. Wang and F.-Y. Hong 2083 Application of MRAC theory for adaptive control of a constrained robot manipulator

Y.C. Kim and B.M. Kim 2099 A study on the corner filling in the drawing of a rectangular rod from a round bar

C. Gong, J. Yuan and J. Ni 2119 Nongeometric error identification and compensation for robotic system by inverse calibration

Number 15

Z.Y. Jiang and A.K. Tieu 2139 3-D finite element modelling of ribbed strip rolling

W.Y. Bao and I.N. Tansel 2155 Modeling micro-end-milling operations. Part I: analytical cutting force model

W.Y. Bao and I.N. Tansel 2175 Modeling micro-end-milling operations. Part II: tool run-out

W.Y. Bao and I.N. Tansel 2193 Modeling micro-end-milling operations. Part III: influence of tool wear

S. Lei, Y.C. Shin and F.P. Incropera 2213 Deformation mechanisms and constitutive modeling for silicon nitride undergoing laser-assisted machining

K.G. Ahn and D.W. Cho 2235 An analysis of the volumetric error uncertainty of a three-axis machine tool by beta distribution

M. Koç, T. Allen, S. Jiratheranat and T. Altan 2249 The use of FEA and design of experiments to establish design guidelines for simple hydroformed parts

N.A. Barakat, A.D. Spence and M.A. Elbestawi 2267 Adaptive compensation of quasi-static errors for an intrinsic machine

Y.S. Liao and J.C. Woo 2293 Design of a fuzzy controller for the adaptive control of WEDM process

AUTHOR INDEX

Abu-Zahra, N. H., 1619
Adsul, S. G., 1003
Ahn, K. G., 2235
Ai, X., 823
Aini, R., 561
Aleyaasin, M., 809
Alfares, M., 2003
Allanson, D. R., 209
Allen, T., 2249
Altan, T., 133, 713, 2249
Arkan, T. T., 599, 609
Arsecularatne, J. A., 1709

Badger, J. A., 1099, 1787
Bao, W. Y., 599, 609, 2155, 2175, 2193
Barakat, N. A., 833, 2267
Barré, F., 1171
Becze, C. E., 869
Bedi, S., 185
Bhaskara Reddy, S. V., 401
Bhat, V., 1951
Bhutta, M. A., 1849
Bidhendi, I. M., 623
Budair, M. O., 1023

Cao, J., 113
Chen, C. C., 363
Chen, J. S., 513
Chen, L., 869
Chen, S.-C., 957
Chen, S.-L., 381
Chen, W., 455
Chen, W.-R., 675
Cheng, K., 259
Cheng, P. J., 1185
Cheung, C. F., 979
Chiou, R. Y., 641, 927
Chitkara, N. R., 1849
Cho, D. W., 2235
Cho, I., 1813
Cho, P. J., 277
Choi, J.-C., 1311
Choi, W., 1813
Chou, S.-Y., 327
Choudhury, S. K., 887, 899
Chow, H. M., 1403
Chu, C. N., 277
Chung Yee Hian, S. H., 1215
Chungchoo, C., 1879
Clayton, P., 869
Colás, R., 1977

Danckert, J., 1479
De Meter, E. C., 467, 1951
Dean, T. A., 621, 1637
DeVor, R. E., 1121, 1929
Dharan, C. K. H., 415
Di Ilio, A., 173
Dimla Snr., D. E., 739, 769, 1073
Dixit, P. M., 95
Dong, S., 445
Dong, X., 81
Du, R., 1385
Dwang, I. C., 513

Ebbrell, S., 209
Ebrahimi, M., 561, 809
Ehmann, K. F., 1, 21, 489
El-Axir, M. H., 1603
El-Wardany, T. I., 869
Elbestawi, M. A., 539, 833, 869, 2267
Elsharkawy, A., 2003
Ema, S., 1141
Ertekin, Y. M., 1199

Fan, K. C., 2073
Feng, H.-Y., 1557
Fernandes, K. J., 1547
Forcellese, A., 1285

Gabrielli, F., 1285
Gao, Z., 691
García-Gil, G., 1977
Gökler, M. I., 1831
Gong, C., 2119
Grabec, I., 225
Grandhi, R. V., 691
Gunasegaram, D. R., 623

Hans Raj, K., 851
Hassan, A. M., 1775
Heikkala, J., 1535
Herscovici, D., 363
Hinds, B. K., 1443
Hocheng, H., 1651
Hong, F.-Y., 2083
Hoogen, M., 1993
Hu, P-H., 1, 21
Hu, S. J., 343
Hu, W., 1587
Hu, Z. M., 1637
Huang, C. Z., 823
Huang, M.-C., 1913
Huang, S., 81
Huang, T.-Y., 783
Hwang, J.-H., 1311

Incropera, F. P., 2213
Ismail, F., 185

Jain, V. K., 1003
Jen, Y. W., 381
Jiang, Z. Y., 2139
Jin, R., 795
Jiratheranat, S., 2249
John, R., 1993
Jouraij, J., 1385
Jywe, W.-Y., 1899

Kang, B.-S., 1691
Kang, D. C., 1479
Kang, S.-W., 1065
Kapoor, S. G., 1121, 1929
Kato, T., 527
Kelly, M. J., 2031
Kim, B. M., 911, 1457, 2099
Kim, B.-M., 1311, 1329
Kim, D. J., 911
Kim, G. M., 277
Kim, J., 1691
Kim, W.-S., 427
Kim, Y. C., 2099
Kinsey, B. L., 113
Kishore, K. K., 899
Ko, D. C., 1457
Ko, D.-C., 1311, 1329
Koç, M., 2249
Kolahan, F., 1735
Krishnakumar, K., 579

Lal, G. K., 95
Lang, L. H., 1479
Lappalainen, K., 1535
Lee, C. M., 33
Lee, D. S., 1493
Lee, K., 1813
Lee, S. G., 1215
Lee, S. K., 1457
Lee, S. W., 1493
Lee, W. B., 979
Lei, L.-P., 1691
Lei, S., 2213
Leu, D.-K., 65
Leung, A. Y. T., 1587
Li, C., 445
Li, H., 2047
Li, S., 81
Li, W., 527, 661
Li, X., 2047
Li, Y., 259, 259
Liang, M., 1735
Liang, S. Y., 641, 927

Liao, Y. J. G., 343
Liao, Y. S., 2293
Lin, J.-R., 1671
Lin, R.-S., 1513
Lin, S. C., 1185
Lin, Y. C., 1403
Lister, P. M., 739, 769
Liu, C.-H., 1899
Liu, X., 1573
Lo, C-C., 307
Lo, K., 943
Lopez, J., 1171
Lynagh, N., 561

Mahendrakar, N., 599, 609
Mannan, M. A., 1235, 1257
Marafona, J., 153
Marui, E., 1141
Mathew, P., 1709
McCaffrey, N. J., 623
McCool, M., 599, 609
Mekid, S., 1039, 1051
Melkote, S. N., 579
Menart, D., 1299
Meng, Q., 1709
Min, G.-S., 1311
Mize, C. D., 1527
Momani, A. M. S., 1775
Monaghan, J., 1351
Müller, F., 1351

Narendran, T. T., 401
Ni, J., 2119
Nielsen, K. B., 1479

Ohmori, H., 527, 661
Okafor, A. C., 1199
Olejniczak, O., 1051
Otho, A., 1157, 1367
Ozanözgü, A. M., 1831
Özel, T., 133, 713

Pahk, H. J., 1493
Paoletti, A., 173
Patel, A. J., 489
Pater, Z., 49
Patvardhan, C., 851
Poo, A. N., 1235, 1257
Portman, V., 1423
Pyttel, T., 1993

Qiu, H., 259

Rahman, M., 1535
Rahnejat, H., 561
Raja, V. H., 1547
Raju, G., 887
Raman, S., 427
Ramesh, R., 1235, 1257
Ren, J.-X., 165
Renton, D., 539
Rowe, W. B., 209

Saini, D., 1879
Sastry, S., 1121
Seethaler, R. J., 239
Sharma, R. S., 851
Shi, H.-M., 165
Shih, A. J., 1755
Shin, Y. C., 2213
Shisler, B., 599, 609
Shuja, S. Z., 1023
Shunmugam, M. S., 401
Smith, D., 599, 609
Smith, G. T., 293
Smithey, D. W., 1929
Song, Y.-A., 1813
Spence, A. D., 833, 2267
Srivastava, S., 851
Starbek, M., 1299
Starr, A. G., 1587
Su, N., 1557
Sun, C.-W., 327
Susic, E., 225

Tai, C.-C., 1913
Tansel, I. N., 599, 609, 2155, 2175, 2193
Tao, M., 795
Tieu, A. K., 2139
Toncich, D. J., 2031
Tor, S. B., 1215
Torrance, A. A., 1099, 1787
Tounsi, N., 1157, 1367
Treanor, G. M., 1443
Trethewey, M. W., 467
Tridimas, Y. D., 209
Tsai, H. Y., 1651
Tsai, M. S., 1651
Tung, P.-C., 943, 957, 2083

Venkata Reddy, N., 95

Wang, C. C., 1403
Wang, G., 1573
Wang, J., 823
Wang, S.-R., 943, 2083
Wang, X.-B., 165
Warkentin, A., 185
Whalley, R., 809
Won, M. S., 415
Woo, J. C., 2293
Woolley, N. H., 209
Wu, B.-C., 783
Wykes, C., 153

Xie, C., 81
Xie, W., 467
Xiong, S., 1573

Yan, B. H., 1403
Yan, H.-S., 675
Yang, D. Y., 33
Yang, H., 1065
Yang, J. A., 1385
Yao, H., 113
Yellowley, I., 239
Yilbas, B. S., 1023
Young, G.-S., 783
Yu, G., 1619
Yuan, J., 2119

Zhan, J., 795
Zhang, C., 527, 661
Zhang, G., 445
Zhang, S. H., 1479
Zhao, J., 795
Zhao, Y., 2073
Zhou, J. G., 363
Zhou, Z., 1587
Ziegert, J. C., 1527

JOURNAL PACKAGES

Money-saving ways
to buy journals such as...

Atmospheric Environment
Biochemical Pharmacology
Environmental Pollution
Life Sciences
Neuropharmacology
Neuroscience
Tetrahedron Letters
Trends in Pharmacological Sciences

Which libraries benefit?

Those libraries which take all the journals from a package will see an immediate benefit and saving. Libraries which take all but one of the journals may find that they can buy the missing title for a nominal amount.

Take advantage of these packages

Subscription Agents have been informed about these money-saving packages and are in a position to help librarians take advantage of the savings offered. Contact your nearest Regional Sales Office directly for more information and help.

ELSEVIER

PERGAMON

NORTH HOLLAND

EXCERPTA MEDICA

Regional Sales Offices

For customers in Europe, Middle East and Africa
Elsevier Science
Regional Sales Office
Customer Support Department
P.O. Box 211
1000 AE Amsterdam
The Netherlands
Tel: (+31) 20 485 3757
Fax: (+31) 20 485 3432
E-mail: nlinfo-f@elsevier.nl

For customers in the United States & Canada
Elsevier Science
Regional Sales Office
Customer Support Department
P.O. Box 945
New York, N.Y. 10159-0945
U.S.A.
Tel: (+1) 212 633 3730
Toll Free number for North-American customers:
1-888-4ES-INFO (437-4636)
Fax: (+1) 212 633 3680
E-mail: usinfo-f@elsevier.com

For customers in Japan
Elsevier Science
Regional Sales Office
Customer Support Department
9-15 Higashi-Azabu
1-chome
Minato-ku
Tokyo
106-0044 Japan
Tel: (+81) 3 5561 5033
Fax: (+81) 3 5561 5047
E-mail: info@elsevier.co.jp

For customers in Asia and Australasia
Elsevier Science
Regional Sales Office
Customer Support Department
No. 1 Temasek Avenue
#17-01 Millenia Tower
Singapore 039192
Tel: (+65) 434 3727
Fax: (+65) 337 2230
E-mail: asiainfo@elsevier.com.sg

For customers in Latin America
Elsevier Science
Regional Sales Office
Rua Sete de Setembro 111/16
Andar
20050-002 Centro
Rio de Janeiro - RJ
Brazil
Tel: (+55) 21 509 5340
Fax: (+55) 21 507 1991
E-mail: elsevier@campus.com.br

CO815/P1

Did you know contributors to Elsevier Science books or journals are entitled to

30% discount

on all our books*?

*(except multi-volume reference works)

Contact your nearest Elsevier Science office in order to obtain a subject catalogue

Regional Sales Offices

For customers in Europe, Middle East and Africa
Elsevier Science, Regional Sales Office, Customer Support Department, P.O. Box 211, 1000 AE Amsterdam, The Netherlands
Tel: (+31) 20 485 3757, Fax: (+31) 20 485 3432, E-mail: nlinfo-f@elsevier.nl

For customers in the United States & Canada
Elsevier Science, Regional Sales Office, Customer Support Department, P.O. Box 945, New York, N.Y. 10159-0945, U.S.A.
Tel: (+1) 212 633 3730, Toll Free number for North-American customers: 1-888-4ES-INFO (437-4636), Fax: (+1) 212 633 3680
E-mail: usinfo-f@elsevier.com

For customers in Japan
Elsevier Science, Regional Sales Office, Customer Support Department, 9-15 Higashi-Azabu, 1-chome, Minato-ku, Tokyo, 106-0044 Japan
Tel: (+81) 3 5561 5033, Fax: (+81) 3 5561 5047, E-mail: info@elsevier.co.jp

For customers in Asia and Australasia
Elsevier Science, Regional Sales Office, Customer Support Department, No. 1 Temasek Avenue, #17-01 Millenia Tower, Singapore 039192
Tel: (+65) 434 3727, Fax: (+65) 337 2230, E-mail: asiainfo@elsevier.com.sg

For customers in Latin America
Elsevier Science, Regional Sales Office, Rua Sete de Setembro 111/16 Andar, 20050-002 Centro, Rio de Janeiro - RJ, Brazil
Tel: (+55) 21 509 5340, Fax: (+55) 21 507 1991, E-mail: elsevier@campus.com.br

CO815/P2

FROM ELSEVIER SCIENCE...
SCIENCE PUBLISHER TO THE WORLD

CONTENTS DIRECT

A FREE alerting service by E-mail for Elsevier Science journals

ContentsDirect allows you unrivalled access to the Tables of Contents pages of Elsevier Science journals in the following subject areas:

- Chemistry and Chemical Engineering
- Clinical Medicine
- Computer Science
- Earth and Planetary Sciences
- Economics, Business and Management Science
- Engineering, Energy and Technology
- Environmental Science and Technology
- Life Sciences
- Materials Science
- Mathematics
- Physics and Astronomy
- Social Sciences
- Multidiscipline

What does ContentsDirect provide?

- Journal title
- Volume and issue number
- Title of paper
- Names of authors
- Page details
- Anticipated publication date
- News and offers

Why register to ContentsDirect?

- Provides via E-mail advance notice of forthcoming papers, allowing you to reserve the issue at your library.
- Provides an invaluable information resource to scientists and researchers requiring the very latest information on soon-to-be published papers.
- Keeps you at the forefront of current research.
- Enables you to create a personal archive of key journal contents in your field of interest.

How to register for ContentsDirect:

- The quickest way to register for **ContentsDirect** is via Elsevier Science home page on the world wide web.
- Registration is simple and the selection of titles is provided by access to drop down menus of all subject classifications plus a complete listing of all titles available.
- If you wish to select new titles or amend your existing selection - simply re-visit the web site and personally make your changes.

ContentsDirect

Register now!

ContentsDirect

www.elsevier.com/locate/ContentsDirect

www.elsevier.nl/locate/ContentsDirect

www.elsevier.co.jp/locate/ContentsDirect

NB If you can't access the web - please note that you can still register by sending an E-mail to **cdsubs@elsevier.co.uk**

8Z-MPD/2

Receive Regular News of Elsevier's Publications

Elsevier Science mails information on new and existing publications regularly. If you would like to be added to the mailing list please send us your name and full mailing address, indicating your fields of interest:

a subject areas

- Chemistry and Chemical Engineering
- Clinical Medicine
- Computer Science
- Earth and Planetary Sciences
- Economics, Business and Management Science
- Engineering, Energy and Technology
- Environmental Science and Technology
- Life Sciences
- Materials Science
- Mathematics
- Physics and Astronomy
- Social Sciences

ELSEVIER

PERGAMON

NORTH HOLLAND

EXCERPTA MEDICA

Regional Sales Offices

For customers in Europe, Middle East and Africa
Elsevier Science
Regional Sales Office
Customer Support Department
P.O. Box [illegible]
1000 AE Amsterdam
The Netherlands
Tel: (+31) 20 485 3757
Fax: (+31) 20 485 3432
E-mail: nlinfo-f@elsevier.nl

For customers in the United States & Canada
Elsevier Science
Regional Sales Office
Customer Support Department
P.O. Box 945
New York, N.Y. 10159-0945
U.S.A.
Tel: (+1) 212 633 3730
Toll Free number for North-American customers: 1-888-4ES-INFO (437-4636)
Fax: (+1) 212 633 3680
E-mail: usinfo-f@elsevier.com

For customers in Japan
Elsevier Science
Regional Sales Office
Customer Support Department
9-15 Higashi-Azabu
1-chome
Minato-ku
Tokyo
106-0044 Japan
Tel: (+81) 3 5561 5033
Fax: (+81) 3 5561 5047
E-mail: info@elsevier.co.jp

For customers in Asia and Australasia
Elsevier Science
Regional Sales Office
Customer Support Department
No. 1 Temasek Avenue
#17-01 Millenia Tower
Singapore 039192
Tel: (+65) 434 3727
Fax: (+65) 337 2230
E-mail: asiainfo@elsevier.com.sg

For customers in Latin America
Elsevier Science
Regional Sales Office
Rua Sete de Setembro 111/16
Andar
20050-002 Centro
Rio de Janeiro - RJ
Brazil
Tel: (+55) 21 509 5340
Fax: (+55) 21 507 1991
E-mail: elsevier@campus.com.br

CO815/P5

BACK ISSUES OF THIS JOURNAL

SAVE UP TO 25% BY PURCHASING COMPLETE SETS

Customers wishing to purchase complete sets can do so at a saving of 25% off the individual volume price.

MICROFORM EDITIONS

Back issues in microform of Elsevier Science research journals are also available. For further information please apply to your nearest Elsevier Science office.

BACK ISSUES PRICE LIST

Full details of the rates of back issues of all Elsevier Science journals can be found in our Back Issues Price List. Please contact your nearest Elsevier Science office for a copy.

Back issues of this and all other Elsevier Science journals are available in hard copy. New subscribers to a journal may purchase back issues of that publication in hard copy edition at 25% discount off the standard price. Elsevier Science maintains stocks of back issues and orders may be placed with confidence at your nearest Elsevier Science office. Should any issue of a volume be temporarily out of stock at the time of ordering, a high quality photoduplicated copy will be supplied at no extra charge to complete your order.

Regional Sales Offices

For customers in Europe, Middle East and Africa
Elsevier Science, Regional Sales Office, Customer Support Department, P.O. Box 211, 1000 AE Amsterdam, The Netherlands
Tel: (+31) 20 485 3757, Fax: (+31) 20 485 3432, E-mail: nlinfo-f@elsevier.nl

For customers in the United States & Canada
Elsevier Science, Regional Sales Office, Customer Support Department, P.O. Box 945, New York, N.Y. 10159-0945, U.S.A.
Tel: (+1) 212 633 3730, Toll Free number for North-American customers: 1-888-4ES-INFO (437-4636), Fax: (+1) 212 633 3680
E-mail: usinfo-f@elsevier.com

For customers in Japan
Elsevier Science, Regional Sales Office, Customer Support Department, 9-15 Higashi-Azabu, 1-chome, Minato-ku, Tokyo, 106-0044 Japan
Tel: (+81) 3 5561 5033, Fax: (+81) 3 5561 5047, E-mail: info@elsevier.co.jp

For customers in Asia and Australasia
Elsevier Science, Regional Sales Office, Customer Support Department, No. 1 Temasek Avenue, #17-01 Millenia Tower, Singapore 039192
Tel: (+65) 434 3727, Fax: (+65) 337 2230, E-mail: asiainfo@elsevier.com.sg

For customers in Latin America
Elsevier Science, Regional Sales Office, Rua Sete de Setembro 111/16 Andar, 20050-002 Centro, Rio de Janeiro - RJ, Brazil
Tel: (+55) 21 509 5340, Fax: (+55) 21 507 1991, E-mail: elsevier@campus.com.br

CO815/P4

AVAILABLE AT YOUR FINGERTIPS...

THE ELSEVIER SCIENCE CATALOGUE ON THE INTERNET

Features include:

ELSEVIER SCIENCE

Catalogue on INTERNET

- ORDER YOUR **FREE** SAMPLE COPY OF *JOURNAL/ BOOK TITLE* TODAY BY CHECKING ITS CATALOGUE ENTRY

Other features include:-

- All the journals, with complete information about journal editors and editorial boards
- Listings of special issues and volumes
- Listings of recently published papers for many journals
- Complete descriptions and contents lists of book titles
- Clippings of independent reviews of published books
- Book series, dictionaries, reference works
- Electronic and CD-ROM products
- Full text search facilities
- Ordering facilities
- Print options
- Hypertext links
- Alerting facility for new & forthcoming publications
- Updated monthly

TRY IT TODAY!

http://www.elsevier.nl/

For further queries please contact:-

Customer Support Department
Tel: +1 (212) 633 3730
Fax: +1 (212) 633 3680
E-mail: usinfo-f@elsevier.com

Customer Support Department
Tel: +31 (20) 485 3757
Fax: +31 (20) 485 3432
E-mail: nlinfo-f@elsevier.nl

ELSEVIER SCIENCE

Catalogue on INTERNET

CO815/P6

ELSEVIER | PERGAMON | NORTH HOLLAND | EXCERPTA MEDICA